perpendicular to the plane of incidence, the effect of magnetisation is to introduce a component into the reflected ray perpendicular to the original plane of polarisation, whose amplitude, c, is given in the several cases by the following equations, in which i is the angle of incidence, and r of reflection, and k a small constant depending principally on C, and the intensity of the incident ray:—1. When the magnetisation is normal to the reflecting surface. If the incident ray be polarised in the plane of incidence—

$$c=k\,.\,\frac{(1+\cos^2 r)\sin^2 i\sin 2i}{\sin r\,.\,\sin^2(i+r)\,.\,\cos(i-r)}.$$

If it be polarised in a plane perpendicular to the plane of incidence—

$$c=k\frac{\cos^2 r\,.\,\sin^2 i\sin 2i}{\sin r\,.\,\sin^2(i+r)\,.\,\cos(i-r)}.$$

2. When the magnetisation is parallel to the intersection of the surface and the plane of incidence, and the plane of polarisation of the incident ray is either in or perpendicular to the plane of incidence—

$$c=k\frac{\cos r\sin^2 i\sin 2i}{\sin^2(i+r)\cos(i-r)}.$$

This vanishes at the grazing and normal incidences, and, in the case of iron, attains a maximum at about the angle of incidence $i=63^\circ\ 20'$.

I do not obtain any change of phase by reflection in any case; and this is to be expected, as this change of phase probably depends on the nature of the change from one medium to another, which, following M'Cullagh, I have uniformly assumed to be abrupt. Apart from this question of change of phase, my results conform completely to Mr. Kerr's beautiful experiments on the reflection of light from the pole of a magnet, as published in the Philosophical Magazines for May, 1877, and March, 1878.

III. "On Dry Fog." By E. Frankland, D.C.L., F.R.S., Professor of Chemistry in the Royal School of Mines. Received October 29, 1878.

It has often been noticed, especially in and near large towns, that a foggy atmosphere is not always saturated with moisture: thus on the 17th of October last, at 3·30 p.m., during a thick fog in London, the degree of humidity was only 80 per cent. of saturation; and Mr. Glaisher, in his memorable balloon ascents, observed that in passing through cloud or fog the hygrometer sometimes showed the air to possess considerable dryness. In the ascent from Wolver-

hampton, on July 17, 1862, at an altitude of 9,882 feet, and when passing through a cloud so dense that the balloon could not be seen from the car, the dry bulb thermometer read 37°·8 F. and the wet 30·°2, indicating a dew point 17°·9 below the air temperature. Again, on the 30th July in the same year, when at an altitude of 6,466 feet, between the Crystal Palace and Gravesend, and whilst the balloon was passing through a "great mist," the dew point was 12°·7 F. below the temperature of the air. The following is a tabulated statement of other instances in which there was comparative dryness of the air in the midst of cloud or fog:—

Date.	Place of ascent.	Altitude in feet.	Temperature of air.	Degree of humidity. 100 = saturation.
1862.				
August 18th	Wolverhampton	5,922	53°·5 F.	61
1863.				
March 31st	Crystal Palace	3,698	38·5 „	62
April 18th	„ „	9,000	32·5 „	52
„ „	„ „	8,000	34·9 „	73
„ „	„ „	7,000	37·8 „	87
„ „	„ „	6,000	41·0 „	76
„ „	„ „	5,000	45·0 „	67
June 26th	Wolverton	11,000	30·0 „	68
„ „	„	10,000	31·5 „	46
July 11th	Crystal Palace	3,200	65·2 „	57
„ „	„ „	2,600	.. ..	53
„ „	„ „	1,600	.. ..	50
„ „	„ „	1,000	64·7 „	53
1864.				
April 6th	Woolwich	6,000	44·0 „	64
„ „	„	1,000	41·7 „	75
1865.				
Feb. 27th	„	4,400	42·0 „	52

It is thus evident that the air closely surrounding the spherules of water in a mist, cloud or fog, is sometimes far from saturated with moisture; although, as is well known to persons occupied with gas analysis, when a perfectly dry gas is admitted into a moist eudiometer it very rapidly assumes the volume indicating saturation, notwithstanding that the proportion of water surface to volume of gas is obviously far less than that afforded to the interstitial air of a fog.

In a special experiment of this kind, it was found that air dried over calcic chloride became completely saturated with moisture in less than one minute and fifty seconds, when it was passed into a moist glass tube three-fourths of an inch in diameter. It appeared to me, therefore, interesting to inquire under what condition the evaporation from the surface of water can be so hindered as to cause this delay in the saturation of the closely surrounding air. Many years ago I became acquainted with the fact, first noticed I believe by Mr. P.

Spence of Manchester, that the evaporation of saline solutions, kept just below their boiling point in open pans, can be almost entirely prevented by covering the liquid with a thin stratum of coal-tar. It was thus that Mr. Spence effected a considerable saving of fuel in that part of the process of manufacturing alum in which burnt aluminous shale is digested for many hours with hot dilute sulphuric acid; much less fuel being of course required when the digestion was carried on without evaporation, than when steam escaped from the surface of the hot liquid. This simple though important technical application suggested to me a condition of things under which the existence of so-called "dry fog" would be possible. From our manufactories and domestic fires, vast aggregate quantities of coal-tar and paraffin oil are daily distilled into the atmosphere, and condensing upon, or attaching themselves to, the watery spherules of fog or cloud, must of necessity coat these latter with an oily film, which would, in all probability, retard the evaporation of the water, and the consequent saturation of the interstitial air.

The following experiments were made in order to test the validity of this explanation :—

I. Two platinum dishes, containing water and presenting equal surfaces of liquid, were placed side by side in a moderate draught of air; the water in one being coated by a very thin film of coal-tar. By comparing the loss of weight in the two dishes, it was found that during twenty-four hours the evaporation was reduced by the film of coal-tar from 7·195 grms. to 1·124 grms. or 84·4 per cent.

II. In a similar experiment, the evaporation during twenty-four hours was reduced from 7·986 grms. to 1·709 grms., or 78·6 per cent.

In order to imitate more nearly the *modus operandi* of actual smoke in foggy air, the smoke from burning coal was in the next experiments blown upon the surface of the water in one of the platinum dishes, the dishes being placed as before in a draught niche.

III. The evaporation during eighteen hours was reduced from 4·26 grms. to ·969 grm., or 77·3 per cent.

IV. In another experiment, the evaporation during twenty-four hours was diminished from 6·325 grms. to 1·173 grms., or 81·5 per cent., and during forty-two hours from 10·585 grms. to 2·142 grms., or 79·8 per cent.

So far the experiments were made in a current of ordinary air of varying humidity; but they were afterwards repeated with the following results, under a large bell-jar, in which the enclosed air was continually dried by a large surface of concentrated sulphuric acid. As in the last two trials, the film was produced by coal smoke.

V. During forty-eight hours, evaporation was diminished from 5·178 grms. to ·737 grm., or 85·8 per cent.

VI. During twenty-two hours, evaporation was reduced from 2·123 grms. to ·668 grm., or 68·5 per cent.

VII. During twenty-four hours, the reduction was from 2·460 grms. to ·180 grm., or 92·7 per cent.

VIII. In a period of seventy-two hours, the reduction was from 7·638 grms. to ·917 grm., or 88 per cent.

IX. In seventy hours, the evaporation was diminished from 7·732 grms. to 2·586 grms., or 66·6 per cent.

X. In forty-six hours, the diminution was from 4·973 grms. to 1·647 grms., or 66·9 per cent.

Experiments were also made with single drops of water suspended in loops of fine platinum wire, and placed in the bell-jar filled with dry air; but it was found that the oily film had a strong tendency to leave the drop and run up the platinum wire. In a comparative experiment, in which one of the drops was protected by a coal-smoke film, the unprotected drop lost 90 per cent. of its weight in two and a half hours at 16°·6 C.; whilst the protected drop lost only 37·8 per cent. at 17°·8 C. in the same time. Another drop, protected by a film of coal-tar, lost 37·6 per cent. of its weight in two and a half hours, the temperature being 14° C. in the bell-jar.

It is highly probable that if globules of water without any solid support (like those in cloud and fog) could have been operated upon, the retardation of evaporation would have been still more marked, or perhaps altogether arrested; for in all the above experiments the oily films manifested a tendency to break up and attach themselves to the solid support of the water, leaving the surface of the latter partially unprotected.

The results of these experiments point out a condition of very common occurrence, competent to produce "dry fog," whilst they also explain the frequency, persistency, and irritating character of those fogs which afflict our large towns; inasmuch as some of the products of destructive distillation of coal are very irritating to the respiratory organs, and a large proportion of them is scarcely if at all volatile at ordinary temperatures.

My thanks are due to my pupil, Mr. C. G. Matthews, for his assistance in the foregoing quantitative determinations.

IV. "Note on the Inequalities of the Diurnal Range of the Declination Magnet as recorded at the Kew Observatory." By BALFOUR STEWART, F.R.S., Professor of Natural Philosophy in Owens College, Manchester, and WILLIAM DODGSON, Esq. Received November 18, 1878.

We are at present engaged in searching for the natural inequalities